

Flower Visitation Records for Butterflies

(Lepidoptera)

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Interrelationships of plants and insects are of great evolutionary importance. Recent evidence suggests that pollinators and flowers have largely coevolved through time. This paper presents some flower visitation records for butterflies and briefly discusses the interaction of adult butterflies and flower food sources.

Butterflies are an extremely well-known group of organisms. The sheer volume of literature on them staggers the imagination. To my knowledge, no one has collected together the flower-feeding records. No attempt is made here to undertake more than a modest overview, being a survey of sources readily available to me. However, it is apparent that strongly suggestive correlations emerge which are worth considering.

Recently three sources dealing with "intrafloral ecology" have reviewed much of the accumulated knowledge: Baker and Hurd (1968), Stebbins (1970), and Faegri and Pijl (1971). Grant and Grant (1965) give extensive records for insect pollinators of the Polemoniaceae, including 45 butterfly species; these were not duplicated in the records here. An important old paper that has apparently escaped the attention of recent reviewers is that of Robertson (1895). He says, "There are few evident butterfly-flowers. The best of them are commonly visited by long-tongued bees and flies." The field is young and open to speculation.

Other work of note includes Knuth (1906), Robertson (1928), Hingston (1930), Carpenter (1946), Hamm (1948), Clench (1955), Dronamraju (1960), Dronamraju and Spurway (1960), and Emmel (1971). This latter gives a detailed report on the symbiotic relationship of a large hesperine skipper and a *Maxillaria* orchid; it possesses a 43 mm proboscis flexed at several points to probe the coiled corolla tube of the orchid!

Since my knowledge of botany is nil, little attempt is made to interpret the data but rather it is presented in accessible form for botanists. The most striking fact, it seems to me, is that in four separate lines (Ranunculales, Theales, Violales, and Saxifragales), series of rather closely related groups are visited, indicating perhaps

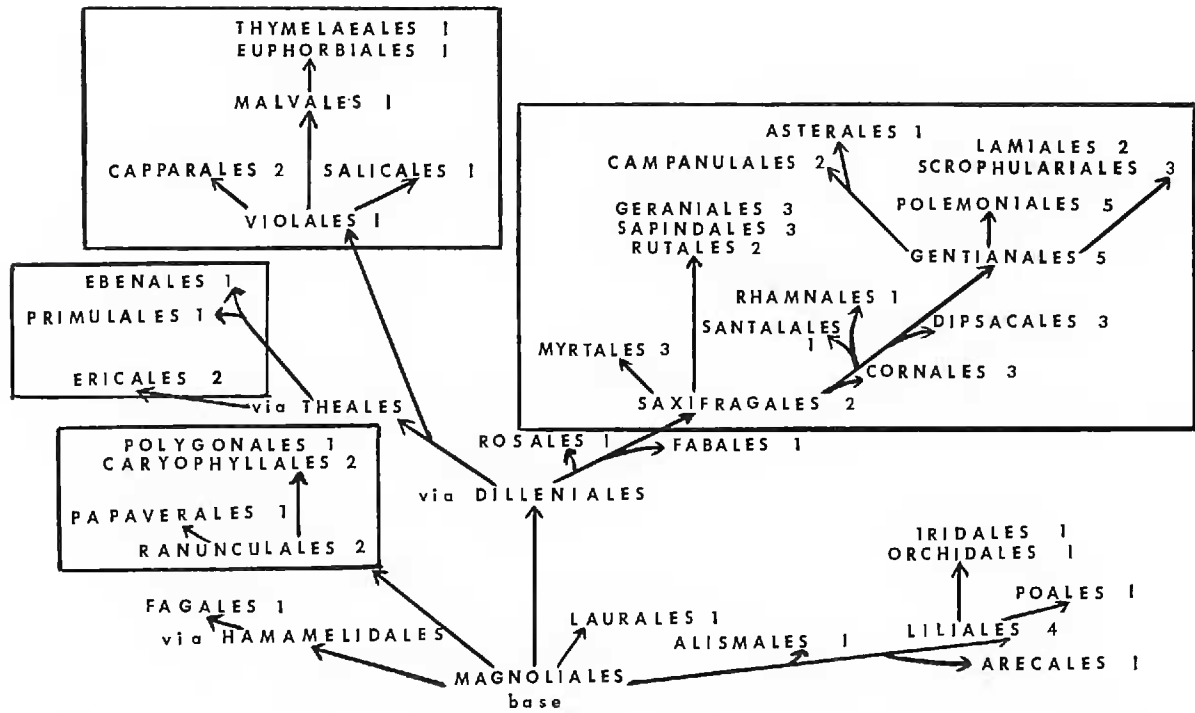


FIG. 1. Plant relationships for butterfly visitations, based on the classification of Takhtajan (1969: fig. 31) (number of plant families used given for each order)¹.

that those groups are interrelated, as the massive botanic evidence strongly suggests (Fig. 1). One would not expect such close similarities if the flower-preference habit developed at random. But 29 of the possible 94 orders are fairly linearly related (in four groups) and only 10 orders more "distantly" related are used. The most primitive dicot orders and the line from Magnoliales through Hamamelidales appear not to be used for the most part, and the monocots are only spottily visited (except Liliales). The flowers chosen by the widest variety of butterfly subfamilies (five or more) include Apocynaceae, Asclepiadaceae, Boraginaceae, Compositae, Cruciferae, Hippocastanaceae, Hydrophyllaceae, Labiatae, Leguminosae, Polygonaceae, Rubiaceae, and Verbenaceae. The commonest family used is Compositae, with 29 genera. The highest similarity in plant orders utilized by two butterfly subfamilies (44%) were the Lycaeninae-Nymphalinae and Hesperinae-Pyrginae lines. More definitive conclusions must await further data. It has been my experience that butterflies do indeed have "preferred" flowers in a given habitat and usually fly past many flower species.

¹ Those families reported in Robertson (1928; records therein are not listed here) that are in addition to those already recorded are Acanthaceae, Acearaceae, Alismaceae, Balsaminaceae, Campanulaceae, Caryophyllaceae, Convolvulaceae, Dipsacaceae, Ebenaceae, Fumariaceae, Gentianaceae, Lobeliaceae, Lythraceae, Oxalidaceae, Polemoniaceae, Pontederiaceae, Primulaceae, Santalaceae, Staphyleaceae, and Valerianaceae.

An intriguing possibility exists here. The butterfly and flower may be evolving within the same habitat, so that a particular flower array may accompany a constellation of butterfly forms through time. Butterflies appear for the most part to be promiscuous in their feeding habits, visiting a variety of the "preferred" types.

According to Faegri and Pijl (1971), butterflies alight on a blossom margin to feed. They characterize the preferred butterfly flowers (psychophily) as being diurnal; no closing at night; weak, pleasant odor; vividly colored; blossom rim not very dissected; erect, radial blossom with flat, often narrow rim; ample nectar hidden in narrow tubes or spurs; and nectar or tongue guide present.

Butterflies often walk over a cluster of blossoms while feeding; thus, pollen could be carried by their legs (e.g., the pollinia of *Asclepias* are pulled out by the monarch butterfly's legs) and bodies. Many butterflies have hair trailing along the inner surface of the hind wing upperside, on the upper and undersurface of the thorax, and the face, which may be important in picking up pollen, as well as the proboscis itself, leg setae, and leg hooks. Hingston (1930) reports an instance where pollen from a *Gloriosa* lily is shaken on the visiting *Papilio* by the action of its wingbeat when feeding. However, the rather casual visitation of flowers by some species may not effect pollen transfer (Percival, 1965: 187). It remains a problem to discriminate between pollen transfer and casual visitation.

Flower feeding by butterflies is often in company with Hymenoptera (especially), Coleoptera, Diptera, and others, e.g. on *Chrysothamnus*, *Cirsium*, *Eriodictyon*, *Eriogonum*, *Melilotus*, *Monardella*, *Prunus*, *Rhus*, and *Solidago*. In the case of *Mimulus*, the pollinators are humming birds, bumble bees, sphingids, and *Papilio* butterflies. In a few instances, butterfly adults feed on the same plant species as their larvae do (*Colias eurytheme* on *Medicago sativa*, *Danaus plexippus* on *Asclepias*, and *Apodemia mormo* and *Philotes rita*, *battoides*, and *enoetes* on *Eriogonum*), but more usually the butterfly adult feeds on plants *other than* its larval foodplant (Faegri and Pijl, 1971: 133). Often the larval foodplant is not in bloom when the butterfly adult is on wing; or if it is, its flowers are usually not attractive to that species.

Many of the flower records given, as far as I can tell, constitute regular rather than casual visitation, but no attempt has been made to distinguish these from rare visits. I once noticed a worn male *Euphydryas chalcedona* avidly feeding on *Sambucus mexicana* blooms, 16 June 1971, Thompson Canyon, just NE of Monticello Dam, Yolo

Co., Calif., on a hot, humid day. *Sambucus* is almost never visited by butterflies, in my experience, but there were few other flowers in bloom on this date.

It may be of evolutionary significance that butterflies of the sub-family Megathyminae (larvae in Agavaceae), generally considered one of the most primitive groups of skippers, do not flower feed but do take moisture along creeks, damp sand, etc. Certain butterfly species with fresh (usually) to worn winged males and worn females will visit moisture. Other non-flower sources for butterflies include carrion, honey dew, rotting fruit, tree sap from wounds, dung, and urine. Thus, perhaps it would have been possible for butterflies to survive at a time when no flowers were available for food, i.e. before the advent of angiosperm flowers (e.g. some lycaenids in Africa feed on lichens as larvae).

Nocturnal feeding at flowers by moths must be extensive since there are about ten times as many moths as butterflies. Though certainly of great interest to evolutionists, this will be difficult data to acquire.

The butterfly *Eumaeus atala* in Florida feeds as an adult on *Serenoa* (Palmae) and *Bidens* (Compositae), while its larva eats *Zamea integrifolia* (Cycadaceae) (Klots, 1951). *Serenoa* being a small palm, and the relationship of Lycaeninae to the other butterflies at present being obscure and ancient, one wonders about a possible early Mesozoic association between *Serenoa*, *Zamea*, and *Eumaeus*.

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BUTTERFLY RECORDS FOR FLOWER VISITATION

AGAVACEAE

Nolina microcarpa: *Erora quaderna* 45²

AMARYLLIDACEAE

Allium douglasi: *Mitoura spinetorum* 54

Brodiaea sp.: *Battus philenor hirsuta*, *Erynnis tristis*, *Papilio zelicaon* (all 69)

Brodiaea pulchra: *Battus philenor hirsuta* 69

ANACARDIACEAE

Rhus glabra: *Chlosyne nycteis* 25

² Numbers refer to literature cited at the end of this article.

Rhus trilobata: *Callophrys apama homoperplexa* 71, *C. comstocki*, *Incisalia iroides*, *Mitoura johnsoni* (all 69), *M. spinetorum* 54

APOCYNACEAE

Apocynum sp.: *Apodemia nais* 3, *Chlosyne leanira* ssp., *C. palla*, *Emesis zela* (all 69), *Epargyreus clarus* 62, *Euphydryas anicia* 3, *Hesperia harpalus oregonia* 53, *Limenitis lorquini* 69, *Lycaena editha* 69, *Phyciodes campestris* 53, *Piruna pirus* 3, *Satyrium liparops* 62, *S. sylvinus* 69, *Speyeria egleis* ssp. 69, *S. hydaspe purpurascens* 53, *S. zerene conchyliatus* 53

Apocynum androsaemifolium: *Speyeria callippe juba* 71

Apocynum cannabinum: *Chlosyne nycteis* 25, *Lephelisca borealis* 57, *Limenitis archippus* 71, *Satyrium alcestis* 41, *S. falacer* 7 & 8, *S. liparops strigosum* 8, *S. ontario* 8

Trachelospermum sp.: *Atlides halesus* 29, *Papilio polydamas* 29

ARALIACEAE

Aralia hispida: *Colias interior* 29

ASCLEPIADACEAE

Asclepias incarnata: *Atrytone conspicua* 29, *Chlosyne nycteis* 25, *Danaus plexippus* 6, *Poanes massasoit* 29, *Speyeria cybele* 6, *S. idalia* 6

Asclepias syriaca: *Danaus plexippus* 6, *Epargyreus clarus* 8, *Satyrium acadica* 52, *S. falacer* 7, *S. liparops* 62, *S. titus mopsus* 6, *Speyeria cybele* 6 & 8

Asclepias tuberosa: *Chlosyne ismeria* 41, *C. nycteis* 25, *Colias philodice*, *Danaus plexippus*, *Everes comyntas* (all 6), *Nathalis iole* 41, *Phyciodes tharos* 6, *Satyrium falacer*, *S. ontario autolytus*, *S. titus mopsus* (all 41), *Speyeria cybele* 8, *Vanessa cardui* 41

BERBERIDACEAE

Berberis sp.: *Incisalia eryphon* 71, *Mitoura spinetorum* 54

BORAGINACEAE

Echium vulgare: *Achalarus lyciades*, *Thorybes bathyllus*, *T. pylades* (all 8)

Heliotropium sp.: *Cercyonis silvestris* 69, *Lycorea ceres atergatis* (to dried plant) 34, *Pseudocopaeodes eunus* 69

Heliotropium indicum (dried plants): *Danaus plexippus*, *Hymenitis andromica*, *Hypothyris euclea*, *Ithomia drymo*, *Lycorea ceres*, *Mechanitis isthmia*, *Melinaea lilis*, *Tithorea harmonia* (all 21)

Tournefortia argentia (dead twigs): *Danaus melissa* 21, *Euploea* ssp. 21

CAPPARIDACEAE

Cleome serrulata: *Papilio bairdii brucei* 69

CAPRIFOLIACEAE

Sambucus coerulea: *Mitoura spinetorum* 54

Triosteum perfoliatum: *Speyeria cybele* 6

COMPOSITAE

Achillea sp.: *Euphydryas editha baroni*, *Lycaena editha*, *Mitoura nelsoni* (all 69), *M. spinetorum* 54, *Satyrium californica* 53, *S. dryope* 69, *Speyeria atlantis nausicaa* 69

Achillea millefolium: *Lycaena nivalis* 35, *Satyrium falacer* 7

Ageratum sp.: *Papilio polydorus queenslandicus* 2

Anaphalis sp.: *Mitoura spinetorum* 54

Anaphalis margaritacea: *Callophrys apama homoperplexa*, *Mitoura siva*, *M. spinetorum* (all 71)

Antennaria sp.: *Incisalia augustinus* 6, *I. nippon* 6

- Antennaria parvifolia*: *Mitoura spinetorum* 54
Arnica alpina: *Colias nastes* 66
Arnica cordifolia: *Lycaena rubidus* 9
Aster sp.: *Colias croceus*, *Gonepteryx rhamni*, *Lycaena phlaeas*, *Maniola jurtina*, *Nymphalis io*, *N. urticae*, *Pieris brassicae*, *P. rapae*, *Polygonia c-album*, *Polyommatus icarus*, *Vanessa atalanta*, *V. cardui* (all 24)
Aster canescens: *Lycaena mariposa* 9
Baccharis sp.: *Libytheana bachmanii* 70
Baccharis sarothroides: *Hylephila phylaeus* 69
Bidens sp.: *Atlides halesus*, *Eumaeus atala*, *Hemiargus thomasi*, *Strymon maesites* (all 29)
Carduus californicus: *Speyeria nokomis apacheana* 9
Chrysanthemum leucanthemum var. *pinnatifidum*: *Satyrium falacer* 7
Chrysothamnus sp.: *Hesperia harpalus* 69, *H. h. leussleri* 3, *H. juba* 69, *Libytheana bachmanii* 71, *Satyrium acadica coolinensis* 50, *Speyeria callippe* ssp. 71
Chrysothamnus nauseosus: *Speyeria egleis tehachapina* 15
Cirsium sp.: *Hesperia columbia*, *H. harpalus dodgei*, *H. lindseyi* (all 33), *Satyrium falacer* 7
Cirsium arvense: *Danaus plexippus* 22
Cirsium vulgare: *Danaus plexippus* 22
Coreopsis sp.: *Zerene cesonia* 58
Coreopsis lanceolata: *Chlosyne gorgone* 32, *Lephelisca virginiensis* 32
Echinacea pallida: *Chlosyne nycteis* 25
Erigeron sp.: *Chlosyne damoetas malcolmi* 69, *Mitoura spinetorum* 54
Erigeron philadelphicus: *Boloria selene* 36
Erigeron ?strigosus: *Satyrium falacer* 7
Eriophyllum lanatum: *Lycaena nivalis* 35
Eupatorium sp.: *Limenitis archippus* 71
Eupatorium coelestinum: *Ancyloxypha numitor*, *Hylephila phylaeus*, *Precis lavinia coenia* (all 6)
Eupatorium purpureum: *Danaus plexippus* 6, *Hesperia leonardus* 6
Gaillardia sp.: *Mitoura spinetorum* 71
Gnaphalium sp.: *Incisalia niphon* 6, *Polygonia gracilis* 29
Grindelia sp., probably: *Ochlodes yuma* 71
Haplopappus sp.: *Mitoura siva* 71, *M. spinetorum* 54, *Speyeria callippe* 69
Haplopappus bloomeri: *Hesperia harpalus yosemite* 65
Haplopappus linearifolius: *Mitoura loki* 69
Helenium sp.: *Mitoura spinetorum* 54, *Speyeria atlantis nikias* 71
Helenium autumnale: *Euptoieta claudia* 40, *Phyciodes tharos* 40
Helianthus annuus: *Satyrium calanus* 32
Pluchea camphorata: *Chlosyne nycteis* 25
Rudbeckia sp.: *Atrytone arogos iowa* 3
Rudbeckia laciniata: *Speyeria zerene platina* 3
Senecio sp.: *Parnassius clodius baldur* 20, *Speyeria callippe* ssp. 3 & 71
Senecio douglasii monoensis: *Mitoura spinetorum* 54
Senecio longilobus: *Sandia macfarlandi* 28
Solidago sp.: *Cercyonis boopis*, *Danaus plexippus*, *Mitoura nelsoni*, *Neophasia*

menapia, *Pholisora libya*, *Satyrium dryope* (all 69), *S. saepium* 3, *Speyeria nokomis apacheana* 69

Solidago canadensis: *Danaus plexippus* 6

Solidago gigantea, probably: *Callipsyche behrii* 12, *Mitoura nelsoni* 12, *M. spinetorum* 12 & 54, *Satyrium californica* 12

Vernonia sp.: *Autochton cellus* 29

Wyethia, or *Balsamorhiza* sp.: *Parnassius clodius sol* 69, *Speyeria callippe juba* 69, *S. c. nevadensis* 20, *S. coronis* ssp., *S. cybele leto*, *S. hydaspes*, *S. zerene* (all 53 & 69)

Zinnia sp.: *Chlosyne nycteis* 25

CORNACEAE

Cornus canadensis: *Mitoura johnsoni* 54

CRASSULACEAE

Dudleya cymosa: *Papilio indra* 69

Sedum sp.: *Speyeria callippe* ssp. 3

CRUCIFERAE

Arabis blepharophylla: *Incisalia fotis bayensis* 69

Barbarea vulgaris: *Strymon melinus* 6

Brassica sp.: *Anthocaris cethura*, *Colias eurytheme*, *Erynnis tristis* (all 69), *Incisalia niphon* 6, *Leptotes marina* 69, *Speyeria callippe comstocki* 71, *Strymon melinus* 69, *Vanessa carye* 69

Brassica nigra: *Pieris rapae* 69

Cardamine bulbosa: *Incisalia niphon* 47

Erysimum sp.: *Speyeria callippe macaria* 51

Erysimum asperum: *Parnassius clodius baldur* 19, *Papilio zelicaon* 20

Rorippa sp.: *Emesis zela* 69, *Mitoura johnsoni* 54

Sisymbrium loeseli: *Lycaena rubidus*, *Polygonia zephyrus*, *Speyeria zerene cynna* (all 69)

ERICACEAE

Arctostaphylos sp.: *Mitoura spinetorum* 54

Arctostaphylos nevadensis: *Mitoura johnsoni* 54

Gaylussacia sp.: *Incisalia henrici* 29

Rhododendron sp.: *Tros philoxenus* 68

Vaccinium sp.: *Graphium marcellus* 6, *Incisalia henrici* 29, *I. niphon* 6, *Thorybes pylades* 6

EUPHORBIACEAE

Croton sp.: *Libytheana bachmanii* 71

Croton linearis: *Lerodea eufala* 48

Poinsettia sp.: *Pratapa cleobis* 68

FAGACEAE

Castanopsis sp.: *Satyrium kingi* 11

GERANIACEAE

Erodium cicutarium: *Vanessa cardui* 30

GRAMINEAE

Sorghum sp.: *Libytheana bachmanii larvata* 70

HIPPOCASTANACEAE

Aesculus sp.: *Aporia leucodyce*, *Delias belladonna*, *Tros philoxenus*, *Zetides cloanthus*, *Z. sarpedon* (all 68)

Aesculus californica: *Chlosyne leanira* 69, *Epargyreus clarus* 20, *Euphydryas*

chalcedona 20, *Incisalia iroides*, *Mitoura spinetorum*, *Ochlodes agricola* (all 69), *Satyrium adenostomatis* 53, *S. auretteorum* 20 & 53, *S. saepium* 20 & 53, *Speyeria callippe inornata* 69, *S. egleis atossa* 9

HYDROPHYLLACEAE

Eriodictyon sp.: *Atlides halesus*, *Celastrina argiolus echo*, *Cercyonis silvestris paulus*, *Euphydryas editha baroni*, *E. chalcedona*, *Heliopetes ericetorum*, *Hemiargus isola*, *Ministrymon leda*, *Mitoura johnsoni*, *M. nelsoni* (all 69), *M. spinetorum* 54, *Ochlodes agricola*, *Papilio eurymedon*, *P. indra pergamus*, *Satyrium auretteorum*, *S. californica* (all 69), *Speyeria callippe macaria* 51

Eriodictyon angustifolium: *Mitoura spinetorum* 54

Eriodictyon californicum: *Hesperia columbia* 33, *Satyrium californica* 20, *Speyeria callippe macaria* 71

IRIDACEAE

Iris sp.: *Carterocephalus palaemon* 64, *Mitoura spinetorum* 54, *Papilio rutulus arizonensis* 71, *Parnassius clodius* 69

Iris missouriensis: *Coenonympha tullia mono* 69, *Papilio rutulus* 69

LABIATAE

Marrubium vulgare: *Erynnis funeralis* 9, *Speyeria callippe macaria* 51 & 71
Monarda sp.: *Erora quaderna* 45, *Speyeria aphrodite ethne* 3 & 69, *S. coronis*, *S. c. halcyone*, *S. cybele leto*, *S. hydasphe*, *S. zerene garretti* (all 69)

Monarda menthaefolia: *Ochlodes snowi* 3

Monardella sp.: *Cercyonis silvestris* 69, *Chlosyne hoffmanni* 20, *Oeneis nevadensis* 69, *Speyeria atlantis dodgei* 69, *S. callippe inornata* 53, *S. c. juba* 69, *S. hydasphe* 20, *S. zerene malcolmi* 20

Monardella odoratissima: *Chlosyne hoffmanni* 19, *Papilio zelicaon* 17, *Parnassius clodius baldur* 19, *Plebejus shasta*, *Polygonia zephyrus*, *Speyeria egleis* (all 17)

LAURACEAE

Umbellularia californica: *Lycaena arota* 20, *Incisalia iroides* 69, *Mitoura johnsoni* 69

LEGUMINOSAE

Astragalus sp.: *Yvretta rhesus* 3

Bauhinia sp.: *Trogonoptera brookiana albescens* 10

Cercis sp.: *Incisalia henrici* 29

Cercis canadensis: *Incisalia henrici* 6

Cercis occidentalis: *Incisalia iroides* 69

Crotalaria sp.: *Jamides celeno aelianus* 10

Lupinus sp.: *Incisalia eryphon* 3, *I. niphon* 6 & 29, *Mitoura nelsoni* 69, *M. spinetorum* 54

Medicago sativa: *Cercyonis silvestris paulus* 9 & 69, *Chlosyne minuta* 71, *C. nycteis* 71, *Colias eurytheme*, *Heliopetes ericetorum*, *Hemiargus gyas*, *Hesperia harpalus*, *Leptotes marina*, *Pholisora catullus* (all 69), *Phyciodes tharos* 71, *Polites themistocles* 69, *Speyeria edwardsii* 71, *Zerene eurydice* 9

Melilotus sp.: *Cercyonis silvestris paulus* 9

Melilotus albus: *Chlosyne nycteis* 25, *Everes comyntas* 6, *Satyrium falacer* 7, *S. liparops* 62

Melilotus officinalis: *Satyrium falacer* 7

Trifolium pratense: *Colias eurytheme*, *Danaus plexippus*, *Hylephila phylaeus* (all 6), *Satyrium falacer* 7

LILLACEAE

Camassia scilloides: *Hesperia metea* 26

Gloriosa superba: *Papilio demoleus* 27, *P. polytes* 27

LOGANIACEAE

Buddleia sp.: *Badamia exclamationis* 68, *Chlosyne nycteis* 25, *Delias belladonna* 68, *Dilipa morgiana* 68, *Limenitis archippus* 71, *Papilio polyctor*, *Zetides cloanthus*, *Z. sarpedon* (all 68)

MALVACEAE

Hibiscus sp.: *Catopsilia crocale*, *C. florella gnoma*, *C. pomona*, *C. pyranthe minna* (all 56)

Sida hederacea: *Strymon columella* 71

MYRTACEAE

Psidium guajava: *Papilio aristodemus ponceanus* 49

ONAGRACEAE

Epilobium sp.: *Mitoura spinetorum* 71

ORCHIDACEAE

Bonatea darwinii: *Pyrgus elmo* 61

Maxillaria ontoglossom: *Perichares philetas dolores* 16

Orchis pyramidalis: *Syricthus alveolus* 61

Platanthera hookeri: *Nisoniades* sp. 61

Pogonia ?ophioglossides: *Poanes hobomok* 37

PALMAE

Serenoa sp.: *Eumaeus atala* 29

POLYGONACEAE

Eriogonum sp.: *Libytheana bachmanii* 71, *Speyeria egleis tehachapina* 15

Eriogonum deserticola: *Eurema nicippe* 69, *Microtia dymas imperialis* 69

Eriogonum fasciculatum: *Cercyonis silvestris* 69, *Hemiargus isola* 69, *Mitoura spinetorum* 54, *Philotes battoides bernardino*, *Satyrium sylvinus*, *Speyeria callippe comstocki* (all 69)

Eriogonum giganteum: *Strymon avalona* 9

Eriogonum umbellatum: *Mitoura spinetorum* 54, *Satyrium saepium* 3

Eriogonum wrightii: *Apodemia mormo tuolumnensis* 69

Polygonum sp.: *Limenitis archippus* 71, *Mitoura spinetorum* 54

PORTULACACEAE

Calyptridium sp.: *Lycaena cupreus* 69, *Mitoura nelsoni* 20, *M. spinetorum* 54, *Nymphalis milberti* 69, *Philotes enoptes* 69, *Speyeria callippe elaine* 53, *S. c. juba* 69, *S. egleis* 71

Calyptridium umbellatum: *Mitoura johnsoni* 54, *Satyrium californica* 20

PYROLACEAE

Monotropa uniflora: *Epargyreus clarus* 6

RANUNCULACEAE

Clematis sp.: *Tros philoxenus* 68

Delphinium carolinianum: *Hesperia metea* 26

Ranunculus sp.: *Hesperia columbia* 33

Ranunculus californicus: *Incisalia fotis bayensis* 69

RHAMNACEAE

Ceanothus sp.: *Apodemia nais* 3, *Incisalia iroides* 69, *Mitoura nelsoni muiiri* 69

Ceanothus americanus: *Satyrium edwardsii* 42, *S. ontario* 29, *S. titus* 42, *S. t. mopsus* 6

Ceanothus cordulatus: *Mitoura johnsoni* 38 & 54, *M. spinetorum* 38 & 54

Ceanothus fendleri: *Erora quaderna* 45, *Mitoura spinetorum* 54

Ceanothus ovatus: *Mitoura spinetorum* 54

ROSACEAE

Chamaebatia foliolosa: *Mitoura nelsoni* 53 & 69

Dryas octopetala: *Boloria alberta* 67, *B. astarte* 67

Fragaria sp.: *Hesperia metea* 29, *Mitoura johnsoni* 54

Fragaria virginiana var. *illinoensis*: *Hesperia metea* 26

Potentilla sp.: *Hesperia metea* 29, *Mitoura nelsoni* 69

Potentilla fruticosa: *Lycaena rubidus sirius* 3, *Mitoura spinetorum* 54

Prunus sp.: *Callophrys dumetorum* 71, *Glaucopsyche lygdamus* ssp. 69, *Incisalia eryphon* 3, *I. niphon*, *Limenitis weidemeyerii*, *Speyeria aphrodite ethne*, *S. coronis* ssp., *S. edwardsii* (all 71)

Prunus americana: *Incisalia niphon* 47, *Mitoura spinetorum* 54

Prunus fasciculata: *Callophrys comstocki* 69, *C. dumetorum* 69, *Mitoura spinetorum* 54

Prunus emarginata: *Incisalia eryphon* 69, *Mitoura nelsoni* 69

Prunus melanocarpa: *Limenitis weidemeyerii* 71, *Mitoura spinetorum* 54, *Speyeria coronis halcyone* 71

Prunus virens: *Erora quaderna* 45

Rubus sp.: *Libytheana bachmanii* 70

Spiraea latifolia: *Celastrina argiolus pseudargiolus* 6

RUBIACEAE

Cephalanthus sp.: *Atrytone conspicua* 29, *Autochton cellus* 29

Cephalanthus occidentalis: *Atalopedes campestris*, *Atrytone pontiac*, *Colias eurytheme*, *Epargyreus clarus*, *Speyeria cybele* (all 6)

Ixora sp.: *Papilio demolion* 10

Morinda roioc: *Papilio aristodemus ponceanus* 49

Mussaenda sp.: *Trogonoptera brookiana albescens* 10

RUTACEAE

Thamnosma montana: *Papilio indra fordi* 69

SALICACEAE

Salix sp.: *Callipsyche behrii*, *Cercyonis oetus*, *Chlosyne acastus*, *C. leanira alma* (all 69), *Mitoura spinetorum* 54, *Satyrium californica* 69

SAXIFRAGACEAE

Hydrangea sp.: *Autochton cellus* 29

Philadelphus lewisii var. *californicus*: *Satyrium auretorum spadix* 20

Ribes sp.: *Mitoura spinetorum* 71

SCROPHULARIACEAE

Castilleja sp.: *Papilio indra pergamus* 69

Mimulus sp.: *Battus philenor hirsuta* 69

Penstemon montanus: *Papilio eurymedon albanus* 3

Penstemon tolmiei ssp. *formosus*: *Speyeria callippe semivirida* 53 & 69, *S. coronis*, *S. egleis* ssp., *S. zerene* ssp. (all 53)

Veronica sp.: *Chlosyne nycteis* 25

SOLANACEAE

Lycium andersonii: *Papilio indra fordi* 69

THYMELEACEAE

Primelea sp.: *Anisynta tillyardi*, *Exometoea nycteris*, *Ogyris idmo* (all 4),
Papilio macleayanus 2

UMBELLIFERAE

Cymopterus sp., probably: *Mitoura spinetorum* 54

Daucus carota: *Satyrium falacer* 7

Eryngium yuccaefolium: *Phyciodes tharos* 6

Lomatium dasycarpum: *Callophrys viridis*, *Incisalia fotis bayensis*, *Phyciodes mylitta* (all 69)

Lomatium utriculatum: *Incisalia fotis bayensis* 69

VERBENACEAE

Duranta sp.: *Atella phalantha* 68

Lantana sp.: *Atella phalantha* 68, *Atrophaenura coon doubledayi* 10, *A. nox erebus* 10, *Cethosia chrysippe cydippe* 2, *Cirrochroa regina sophene* 2, *Cynthia erota* 68, *Euripus consimilis* 68, *Graphium agamemnon* 10, *Idea leuconoe* 60, *Ismene jaina* 68, *Jamides celeno aelianus* 10, *Lebadea martha malayana* 10, *Papilio liomedon* 68, *P. polydorus queenslandicus* 2, *Parathyma nefte subrata*, *Parthenos sylvia lilacinus*, *Phalanta alcippe alcesta* (all 10), *Prioneris sita*, *Tros aidoneus*, *T. hector*, *T. jophon*, *Troides helena* (all 68), *Vanessa carye* 9, *Vindula arsinoe erotella* 10, *Zetides agamemnon* 68, *Z. sarpedon* 68

Lantana camara: *Baoris mathias*, *Catopsilia pyranthe*, *Danaus chrysippus*,
Papilio demoleus, *P. polytes*, *Precis almana* (all 13)

Verbena sp.: *Appias lyncida* 68, *Hesperia metea* 26

VIOLACEAE

Viola sp.: *Erynnis brizo* 29

Viola pedata: *Hesperia metea* 26

SUBFAMILY RELATIONSHIPS OF THE BUTTERFLY GENERA MENTIONED

PAPILIONIDAE

Papilioninae: *Atrophaenura*, *Battus*, *Graphium*, *Papilio*, *Trogonoptera*, *Troides*,
Tros, *Zetides*

Parnassiinae: *Parnassius*

PIERIDAE

Pierinae: *Anthocaris*, *Aporia*, *Appias*, *Delias*, *Neophasia*, *Pieris*, *Prioneris*

Coliadinae: *Catopsilia*, *Colias*, *Eurema*, *Gonepteryx*, *Nathalis*, *Zerene*

LIBYTHEIDAE

Libytheana

NYMPHALIDAE

Satyrinae: *Coenonympha*, *Maniola*, *Oeneis*

Danainae: *Danaus*, *Euploea*, *Idea*, *Lycorea*

Ithomiinae: *Hymenitis*, *Hypothyris*, *Ithomia*, *Mechanitis*, *Melinaea*, *Tithorea*

Nymphalinae: *Atella*, *Boloria*, *Cethosia*, *Chlosyne*, *Cirrochroa*, *Cynthia*, *Dilipa*,
Euphydryas, *Euptoieta*, *Euripus*, *Lebadea*, *Limenitis*, *Microtia*, *Nymphalis*,
Phalanta, *Parathyma*, *Parthenos*, *Phyciodes*, *Polygonia*, *Precis*, *Speyeria*,
Vanessa, *Vindula*

LYCAENIDAE

Riodininae: *Apodemia*, *Emesis*, *Lephelisca*

Lycaeninae: *Atlides*, *Callipsyche*, *Callophrys*, *Celastrina*, *Eroria*, *Eumaeus*,

Everes, Glaucopsyche, Hemiargus, Incisalia, Jamides, Leptotes, Lycaena, Ministrymon, Mitoura, Ogyris, Philotes, Plebejus, Polyommatus, Pratapa, Sandia, Satyrium, Strymon

HESPERIIDAE

Trapezitinae: *Anisynta*

Hesperiinae: *Ancyloxipha, Atalopedes, Atrytone, Baoris, Carterocephalus, Hesperia, Hylephila, Lerodea, Nisoniades, Ochlodes, Perichares, Piruna, Poanes, Polites, Pseudocopaeodes, Yvretta*

Coeliadinae: *Badamia, Ismene*

Pyrginae: *Achalarus, Autochton, Epargyreus, Erynnis, Exometoeca, Heliopetes, Pholisora, Pyrgus, Syricthus, Thorybes*

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69. From my field notes and those of J. F. Emmel.
70. From my unpublished ms. on the Libytheidae.
71. Records from correspondence (see acknowledgments).

SCIENTIFIC NOTE

Notes on the Feeding Habits of *Haemolaelaps glasgowi* (Acarina: Laelaptidae).—Specimens of the mite *Haemolaelaps glasgowi* (Ewing), utilized in this study, were recovered from the round-tailed ground squirrel, *Spermophilus tereticaudus neglectus* Merriam, near Tucson, Arizona, or from its nests. Feeding studies were conducted at a mean room temperature of 84°F and at a mean relative humidity of 20%. A juvenile mouse, *Mus musculus* Lin., was thoroughly examined, before placing a mite on it, to ascertain that it was ectoparasite free. All mites placed on the mouse went to the rump. Starved mites were deprived of blood or its constituents for 10 days. Starved adult females remained attached to the dermis from one to two hours after which they appeared engorged. Most of these were on the mouse from 12 to 15 hours. All adult females fed one to three days previously on moist raw beef did not feed on the mouse. Most starved adult females were attracted to the beef. Approximately half of these wandered over it for a minute, probed it with their mouthparts, then fed. They would then go to a different location and repeat this probing and feeding. The time spent on the beef was four to five minutes. One starved adult male fed 20 to 30 seconds on it while one recently fed adult male ignored it. All protonymphs and deutonymphs ignored the raw beef.—JAMES D. LANG, *Department of Entomology, University of Arizona, Tucson, 85721.*